Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 236

Home Canning of Fruits and Vegetables

By

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Demonstrator in Bacteriology

TORONTO, ONTARIO, MARCH, 1916

Printed by
WILLIAM BRIGGS
Corner Queen and John Streets
TORONTO

BULLETIN NO. 236] [MARCH, 1916

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OF

Fruits and Vegetables

E. L. Davies, B.S.A.

INTRODUCTION.

It is only of comparatively recent years that the process of canning fruits and vegetables has been placed on a scientific basis. Preservation of foods of all kinds has been practised for many centuries, although the modern methods were not introduced until early in the nineteenth century, and even at that time the reasons for certain manipulations could not be satisfactorily explained.

As early as the seventeenth century it had been observed that there were plants and animals so minute that they could not be observed without the aid of a powerful microscope. As the years passed, our knowledge of these minute plant organisms increased, and about the middle of the nineteenth century it was shown that some caused disease, others fermentation, and others putrefaction; in fact, that these organisms were of immense importance in nature.

The organisms concerned in the process of canning, or food preservation, are those which produce fermentation or putrefaction in the materials after they have been put away in the jar. Such organisms may be divided into three groups—moulds, yeasts and bacteria.

Moulds.

A white, green or black furry growth, commonly found on spoiled foods, especially on bread kept in damp places, cheese and canned fruits.

Some of these moulds may cause distinct alcoholic fermentation in canned fruit, and at the same time impart a "mouldy" flavour to the material.

The moulds reproduce themselves by spores. These are very small light bodies which are easily carried in the air. When they settle on favourable materials they germinate and produce the typical mould plant. Mould spores are found very commonly on ripe fruit.

Yeasts.

Yeasts are common in every household, being used in breadmaking, and are usually the cause of fermenting canned fruits.

They are very minute plants which are quite invisible to the naked eye. If they gain entrance to substances containing sugar and enough moisture they imme-

diately begin to produce alcoholic fermentation. Yeasts are carried in the air, and are found on most ripe fruits.

The yeasts reproduce themselves by a process of "budding," that is a very small cell appears on the surface of a mature cell, which rapidly grows larger until the size of the mother cell. During growth and multiplication certain enzymes are produced, the enzymes being substances of a chemical nature which decompose the sugars, alcohol and gas being produced.

Bacteria.

These plants are much more minute than either moulds or yeasts, and can only be observed with a powerful microscope. Bacteria vary in size, but it may be said that from 10,000 to 15,000 can be placed end to end, and 30,000 to 50,000 placed side by side, within the space of one inch.

Bacteria reproduce themselves by fission, that is the cell divides into two equal parts. Such division, or reproduction takes place, under normal conditions, once every 30 to 45 minutes, and within 24 hours the progeny of one cell may amount to millions. As these bacteria grow they decompose the material upon which they are growing, such changes in foods being known as putrefaction or decay.

Many bacteria produce very hardy and resistant bodies within the cell, known as spores. These spores are surrounded by a heavy covering or wall, which makes them very resistant to heat, light and chemicals. They are formed by the bacteria when the conditions for growth become unfavourable, as lack of food, moisture, etc., and thus serve as a means of tiding the organism over conditions which would otherwise result in death. As soon as the conditions become favourable the spore germinates, an active cell is formed, and the rapid reproduction soon leads to the presence of millions of cells in the material.

Due to their light weight bacteria, and spores of bacteria, are very prevalent in the air, being carried about by air currents. If the air is heavily laden with dust the numbers are greatly increased, every particle of dust carrying hundreds of bacteria. Anything exposed to the air is soon contaminated with these minute organisms, and if the substance is favourable for growth, the bacteria are soon present in large numbers and make themselves known by the changes they bring about.

The souring of milk is due to bacteria entering from outside sources, on dust or dirt, etc. Putrefaction of foods is brought about by a similar cause. Canned goods are often spoiled by the action of bacteria.

PREPARATION FOR CANNING.

It has been shown that a single cell, or a single spore, can set up fermentation, putrefaction, or spoilage of foods. Also that everything the housekeeper works with, utensils and fruit and vegetables, carries the organisms. This is especially so with the fruits and vegetables. This being the case all care possible must be taken to remove as many organisms as possible and when the fruit is put in the jars those organisms remaining must be killed.

The first part is accomplished by thorough cleanliness; that is, dust and soil must be very carefully washed off the fruit or vegetable to be canned. By removing dust or soil the greatest source of contamination is removed, since these materials abound in spores and active cells. Bruised or cracked fruit should be avoided if

possible, since the yeasts and mould will soon penetrate the tissues and are not easily removed. Rough or cracked vegetables should never be used, especially is this the case with tomatoes, where the soil easily penetrates the tissues and cannot be washed out.

The jars, or containers to be used should be thoroughly scalded before use with hot water.

SCALDING AND BLANCHING.

Scalding means dipping in boiling water momentarily, or having boiling water thrown over the products.

Blanching means holding the products in boiling water for a certain length of time.

Scalding and blanching are done for several reasons. (*a*) To cleanse the products by removing dust, dirt or organisms; (*b*) To remove certain slimy or sticky substances which are present, as in peas and asparagus, which if not removed will give a thick, slimy, green and somewhat objectionable syrup; (*c*) To loosen the skins, as on peaches, tomatoes, etc.; (*d*) To somewhat reduce the bulk of the product, thus avoiding too much shrinkage in the jar.

Times for scalding and blanching the different products are given in the tables at the end.

STERILISATION.

This means the complete absence of living organisms in the canned products. It has been stated that however much care is taken in the cleaning and blanching process the products will still contain some bacteria which if not killed will cause spoilage. These few remaining organisms are enough to cause the damage, and are, as a rule, the most difficult to get rid of because they are often protected in the tissues of the product. There are several methods of ridding the canned material of these organisms, that is of sterilising it. The methods vary with the fruit or vegetable to be canned.

Sterilisation Under Steam Pressure.

This method is only applicable where a pressure boiler is at hand and even then great care must be observed if glass jars are to be used or the losses by cracking will be heavy. If tin cans are to be used the methods go beyond the scope of this bulletin and cannot be discussed.

Sterilisation under pressure renders possible the destruction of spores and active organisms within a comparatively short time, but it has the disadvantage that many of the tender fruits lose their shape and the texture is spoiled.

Intermittent Sterilisation.

This is the method advised for the housekeeper. It is applicable to fruits and vegetables, especially the latter, and can be carried out with absolute success in an ordinary wash boiler to which has been fitted some form of false bottom.

The method consists of heating the products to be canned, in jars, at boiling point for a given period of time, on one, two, or three successive days, the times advised having been determined by actual experiment.

The advantages of this method over any others open to the housekeeper are:

(*a*) Sterilisation is thorough. The product once in the jar is not open to contamination with spores or active organisms, as it is when the product is stewed in open kettles and then filled into the jar.

(*b*) The exposure to temperature may be more satisfactorily varied, so that over or under cooking is minimized.

(*c*) Tender fruits, as raspberries, have a minimum amount of handling, and heating is not so violent. The berries, therefore, retain their natural shape, color and appearance more satisfactorily.

(*d*) Experiments have determined the amount of heat necessary to destroy these organisms, some products needing much less time than others.

(*e*) It enables the canning of vegetables, as peas, beans, corn and tomatoes, which were previously canned only with difficulty.

Explanation of Intermittent Sterilisation.

As previously stated, intermittent sterilisation means heating the products in the container for a definite period of time, on one, two or three successive days.

The method is based on the fact that certain bacteria form very hardy spores. These spores are so resistant to ordinary boiling temperature that in some instances they are not killed by three or four hours, or more, exposure. If fruit and vegetables are exposed to such long heat the texture and shape is apt to be materially changed, the tender fruits especially are reduced to a more or less pulp, and the attractive appearance of the natural fruit is lost.

To overcome this difficulty the process of intermittent sterilisation is advised. The heat applied the first day kills all moulds, yeasts, and active (vegetative) bacterial cells, but not the spores. In the twenty-four hours elapsing between the first and second heating most of the spores germinate, that is, they form the active vegetative cells, and are killed by the second application of heat. A third heating is given after another twenty-four hours' interval, to kill any cells which have formed from spores which had not germinated when the second heating was given.

Thus in three comparatively short periods of heating (15-30 minutes) results are obtained which by constant boiling would require several hours. This form of sterilisation demands more care and attention, but is the only method offering success with vegetables. Most fruits demand only one heating for a brief interval.

Long Exposure to Boiling.

Boiling for extended periods of time has been advised by some writers for vegetables, but experiments conducted in the Department of Bacteriology have shown a large percentage of failures in every case. This is explained by the presence of very resistant spore forms, which are common in the soil. Therefore, exposure of vegetables or fruit to long periods of boiling cannot be advised, such products are more successfully canned by the intermittent method.

Chemicals—Preserving Powders.

Many brands of so-called "Preserving Powders" are found on the market. Small doses may not be immediately harmful to the healthy adult, but continued doses may have detrimental effect on the health. With a child or an invalid the effect may be dangerous. For these reasons, though in many cases the powders do prevent spoilage, their use is not recommended.

Why Some Products Need More Heat to Sterilise Them Than Others.

Different products demand different periods of exposure to heat to be sterilised. This fact is due to several causes which work hand in hand.

(1) Some are cleaner than others, therefore contain fewer spore forms. Those products taken from the soil, such as beans, peas and asparagus, are much more difficult to sterilise, because the soil is the source of many very resistant spore-forming organisms. Thorough washing and blanching does not remove all the spores.

(2) The character of the fruit or vegetable itself. Some are more acid than others, as tomatoes. Bacteria and yeasts do not develop as well in materials so high in acid. The acidity and heat together have a tendency to destroy the organisms more easily. Products such as asparagus, peas, beans, and some of the sweeter fruits, afford a splendid medium for the development of organisms.

Firm fruit and vegetables are less open to the entrance of organisms to the tissues. Soft and easily-broken products, as tomatoes and grapes, are often found cracked when picked. Soil or dust gaining entrance to the tissues by these cracks is washed out only with great difficulty. Protection to the organisms by the tissues thus entered makes sterilisation more difficult.

(3) *Density of the Syrup.* The amount of sugar in the syrup of canned fruits has a great influence on the time necessary for sterilisation.

When the concentration of sugar in a syrup reaches a certain point, bacteria, moulds and yeasts do not develop readily. This is due to the absence of sufficient moisture. The concentration of sugar used with most fruits is so high that bacteria are unable to develop, but is not high enough to prevent the growth of yeasts and moulds. This being the case the most difficult part of sterilisation, the destruction of bacteria, is eliminated. Yeasts and moulds, which can develop in such concentrated solutions, are killed by less exposure to heat than are the bacteria. Thus fruits canned with heavy syrups are sterilised more easily than products in which the bacteria can develop.

1. Pint jar of peaches. 2. Pint jar of raspberries. 3. Pint jar of strawberries. 4. Pint jar of cherries. 5. Wash boiler fitted with perforated false bottom, used for sterilising jars of fruit and vegetables. 6. Pint jar of butter beans. 7. Quart jar of green peas. 8. Quart jar of young corn. 9. Pint jar of asparagus.

DIRECTIONS FOR CANNING.

Jars.

Any jars which can be sealed tightly may be used. It is advisable to use new rings each year. The jars should be thoroughly scalded with boiling water before use.

Boiler.

The ordinary wash boiler may be used to which has been fitted some form of false bottom. The false bottom is necessary to keep the jars from the direct heat of the fire, which otherwise would cause cracking. Galvanized sheet iron serves very well for this purpose. It should be made to fit the boiler easily and should be perforated with ½-inch holes to allow diffusion of water, and should be kept ½-¾ inches off the bottom of the boiler by means of projecting ridges or feet. Convenience is increased by having a wire handle at each end of the false bottom projecting above the water, by which, after heating, the jars can be lifted out all together, the false bottom serving as a rack.

Quality of Fruit or Vegetable.

For reasons stated before, the product to be canned should be fresh and of good quality. Bruised or damaged products should be avoided.

Scalded.

Products having skins to be removed, as tomatoes or peaches, should be dipped in boiling water one-half to one minute, or have boiling water poured over them.

Blanching.

Blanching is done by holding the product for several minutes in boiling water. This removes various substances which spoil the quality of the canned product and with vegetables is an aid to the removal of soil bacteria. After blanching, products should be dipped in cold water to regain their former firmness.

Syrups and Salting.

The syrup to be used varies with the kind of fruit and according to taste. The following syrups were found quite satisfactory in experiments.

Soft and delicately-flavoured fruits, as strawberries, some cherries and raspberries, should be canned in a dense syrup, made of sugar two parts, water one part. With this syrup the natural colour is retained.

Currants, peaches, plums, quinces, sweet cherries, apricots, etc., should be canned in a syrup of medium density, made up of sugar one part, water one part.

For fruit requiring a light syrup, one part of sugar to one and one-half parts water is satisfactory. The syrup is made by dissolving the sugar in hot water, any scum forming on the surface should be removed.

The syrup should be added to the fruit in the jar while hot.

Vegetables are of better flavour if the water added is salted to taste before filling the jar.

Fruit and Syrup in Jar.

The jar should be well filled with fruit, often slight pressure is used to advantage. This does away with excessive empty space due to shrinkage. Large or firm fruits and vegetables, as peaches, and beans, should be cut so that they will pack more closely.

When the fruit is packed, the jar should be stood in warm water to heat the glass ready for the hot syrup. The syrup should be hot when poured over the fruit, and the jar well filled, although jars only partly filled are just as safe and as easily sterilised. The cap and rubber ring are then put on and sealed tightly.

Sterilisation.

The boiler is filled with enough cold water to come an inch or two above the false bottom, or enough water to prevent it boiling dry. More water is unnecessary, it takes much longer to heat, and steam will do the heating as well as the water.

Just before the jars are stood in the boiler, with the water cold, the tops are slightly loosened to allow for expansion. The cover of the boiler should fit closely to prevent unnecessary loss of steam. Time of heating should be taken from the moment the water reaches the boiling point.

When the time is up the boiler should be removed from the heat, but not opened for five or ten minutes. Then the covers should be screwed down tightly, the jars taken from the water and placed on a wood surface away from cold draughts. If the tops are closed immediately the heat is turned off, the pressure becomes very high and may cause trouble with leaky rubbers. It is advisable to stand the jars upside down for the cooling period, then any leaks of air can be observed. If the product only calls for one period of heat, the jars must be observed closely, if leaks occur, as shown by bubbling of air into the jar, the rubber should be changed and sterilisation repeated.

Products to be heated on a second or third time are treated as for the first heating, at intervals of 20-24 hours. Care must be taken to unscrew the top slightly to allow for expansion.

It has been previously stated that the air carries with it numerous mould spores, yeasts and bacteria. Therefore it must be clear that *once the process of sterilisation has been begun, under no condition should the jar be opened to the air.* If air gains admittance by leaks or by removal of the top of the jar, then the work is undone and sterilisation must be repeated. Even the smallest air leak affords space for the passage of such minute organisms as are being dealt with.

Paraffining.

Dipping the head of the jar in paraffin is advised by some, but this is quite unnecessary and only increases the work of canning, and later in washing the jar.

TIME TABLE FOR FRUITS.

Product.	Treatment.	Scald or Blanch.	Syrup.		Sterilisation.
			Sugar.	Water.	
Apples.....	Peel, core, halve or quarter	.....	1 part	1 part	Bring water to boil ½ minute. Allow jars to stand in boiler 20 minutes. Seal tightly.
Apricots....	Halve, pit or pack whole.	1 to 2 mins.	1 part	1 part	Water boiling 5 to 10 mins. according to ripeness of fruit.
Blackberries.	Wash and pick over.....	.....	1 part	½ part	As apples.
Blueberries..	As blackberries.....	.....	.....	.....	.....
Cherries (sour).	Wash, stem and pit.....	.....	1 part	½ part	As apples.
Cherries (sweet).	Wash, stem and pit.....	.....	1 part	1 part	As apples.
Peaches.....	Skin, halve or quarter; pit or pack whole.....	1 to 2 mins.	1 part	1 part	As apricots.
Pears.....	Peel, halve or quarter, core.....	.....	1 part	1 part	As apples.
Plums.....	Pack whole or pit.....	.....	1 part	1 part	As apples.
Raspberries.	Hull.....	.....	1 part	½ part	As apples.
Strawberries	Hull.....	.....	1 part	½ part	As apples.

TIME TABLE FOR VEGETABLES.

Product.	*Treatment.	Blanch.	Sterilisation.
Asparagus....	Wash, cut to jar length.....	5 to 7 mins.	30 minutes on 3 successive days.
Beans (string).	String, cut up or pack whole....	5 to 10 mins.	As asparagus.
Corn (off cob)..	Cut from cob after blanching....	10 to 15 mins.	As asparagus.
Peas.....	Hull.....	5 to 10 mins.	As asparagus.
Tomatoes.....	Skin, core, halve or quarter.....	1 to 2 mins.	15 minutes on 3 days.†

*Salting to taste.

†20 minutes on 2 days has been successful, but cannot be recommended without reserve.